STATEMENT OF DR. AGAM N. SINHA
BEFORE THE HOUSE COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE, SUBCOMMITTEE ON AVIATION HEARING ON ATC MODERNIZATION AND NEXTGEN: NEAR-TERM ACHIEVABLE GOALS

March 18, 2009

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Good morning, Chairman Costello, Ranking Member Petri, and Members of the Subcommittee. Thank you for inviting me to participate in today's hearing on ATC Modernization and NextGen: Near-Term Achievable Goals. My name is Agam Sinha and I am a Senior Vice President at The MITRE Corporation. I am also the General Manager of MITRE's Center for Advanced Aviation System Development (CAASD), which is the Federal Aviation Administration's (FAA's) Federally Funded Research and Development Center (FFRDC).

My testimony today will address many of the initiatives that are supporting the near-term goals for NextGen. To put these into context, I will be addressing some of the following points:

- Passengers flying in the National Airspace System (NAS) are still experiencing increasing delays, even though the overall number of flights has been declining.
- We know, however, that based on history the overall level of traffic will continue to rise in the future; this period of reduced operations provides an opportunity to invest in system improvements before problems become even more difficult to resolve.
- In the near-term, we need to continue to pursue diverse initiatives which require minimal new investments in aircraft avionics or new ATC automation, such as procedures that leverage existing aircraft area navigation capabilities, airspace redesign of metropolitan areas, and early ADS-B applications. In addition to these ongoing initiatives, there are more opportunities to make progress in the near term.
- I will briefly discuss the importance of ensuring that the NAS is well positioned to meet the air traffic demand expected in the 2015-2018 timeframe and beyond.
- Finally, moving forward will require significant collaboration: not only between FAA and the flight operators, the direct customers of the air traffic control system, but between FAA and the many other government entities that contribute to the national transportation system.

Near-Term Needs for Improvements in the National Airspace System

We all have experienced delayed flights and know how disruptive and frustrating air traffic delays can be. In 2008, 2.1 million, or 25% of flights arrived more than 15 minutes late, 12% worse than in 2004[1]. Yet air traffic operations declined by almost 9% during the same period[2]. In fact, the nature of congestion has changed. Congestion has become more localized at large metropolitan areas such as New York and Chicago. According to Bureau of Transportation Statistics, in 2008 Newark Liberty International Airport (EWR) was the most delayed airport with only 62% of flights arriving on time, followed by LaGuardia Airport (LGA) at 63%,

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[1] Based on data from the Federal Aviation Administration's Aviation (FAA) System Performance Metrics (ASPM) database for calendar year 2000 to 2009.
[2] Based on data from the FAA's OPSNET database for the top 75 airports.

Chicago O'Hare (ORD) at 68% and John F. Kennedy International Airport (JFK) at 69%. The effect of these local delays can be seen at the 75 biggest airports where on-time arrivals have decreased from 78% in 2004 to 75% in 2008.

In the aggregate, delays have increased in the NAS, even as operations continue to be lower than they were in 2000 (see Figure 1). However, the distribution of NAS operations has changed significantly over this time period. Although traffic at some airports has certainly declined, operations at many major airports have continued to increase, leading to higher delays across the NAS due to the interdependence and connectivity between airports. For example, summer time traffic (June – August 2008) is up 9% compared to 2000 at 7 airports: Hartsfield-Jackson Atlanta International Airport (ATL), EWR, George Bush Intercontinental Airport (IAH), JFK, LGA, ORD, and Philadelphia International Airport (PHL). Although these 7 airports only accounted for 56% of NAS delays in 2000, they now account for 77% of the delays today.

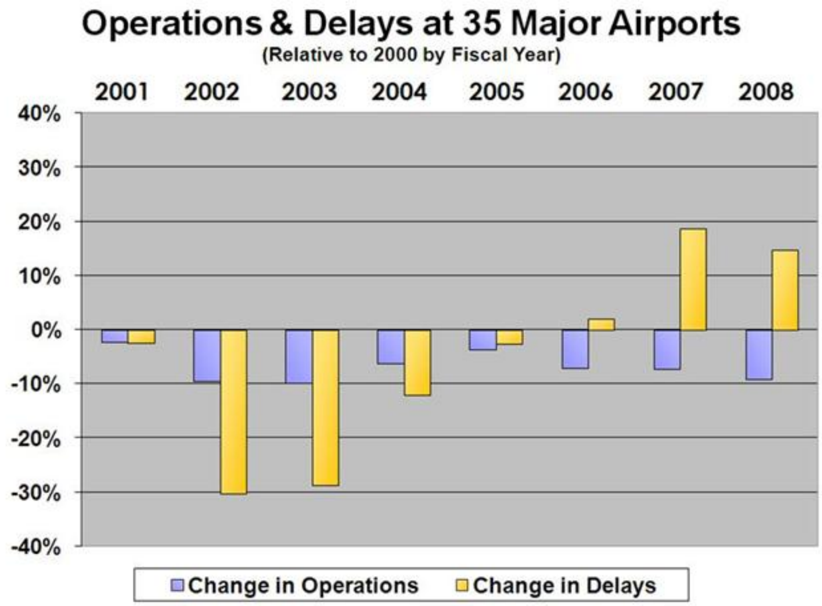


Figure 1

An additional disturbing trend in the data is that despite reductions in operations over the past several years, extremely long delays are increasing. Data shows that over 73,000 flights last year took one hour or more to taxi during departure[3]. Although these delays are less than 1% of the total flights, they are the delays that garner the most attention from the traveling public with stories of aircraft stranded on the tarmac unable to takeoff or return to the gate. The percentage of these delayed flights has steadily increased, doubling since 2002.

Passengers are experiencing this congestion in other ways, as well. During the past three summers the airline industry experienced historically high load factors as operations were reduced at some airports but passenger traffic continued to climb. During this time, load factors reached 84% – 86% for major air carriers, the highest they have been since 1970. Load factors in this range make it more difficult to re-accommodate passengers on cancelled flights, potentially leading to even longer passenger delays and increased inconvenience. In addition, very high load factors may contribute to higher delays, as airlines are more reluctant to cancel flights.

[3] Based on data from the FAA's Aviation System Performance Metrics database for the top 75 airports

Although the current economic crisis is causing a reduction in passenger demand and fewer flights, history tells us that this downturn is temporary and that passenger and flight demand will return. Despite recessions, oil shocks and terrorist attacks since the early 1970's, passenger demand has steadily increased by a factor of four while air travel has steadily become more affordable as airline productivity has improved (see Figure 2).

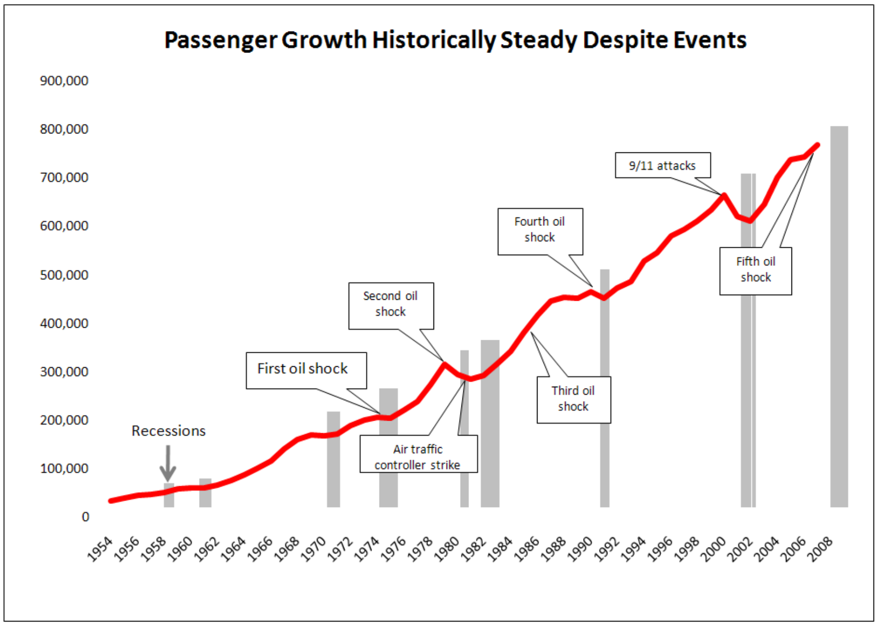


Figure 2

The FAA's 2008-2025 Aerospace Forecast projects that by 2016, over one billion passengers will fly each year, nearly 3 flights a year for every man, woman and child in the U.S. Because there are no immediate solutions that fully address today's air traffic control system limitations, it is imperative that the FAA and the aviation community continue to work toward specific, near-term, achievable goals to begin mitigating problems at the locations where they are occurring. They must seize the opportunity today to get ready for the significantly increased number of flights that will occur as the economy recovers. Along with this growth comes the challenge of maintaining the excellent aviation safety record in the U.S. Continued safety improvements are needed to reduce the rate of accidents. Unless the rate of accidents is lowered, overall perceptions of aviation safety may be undermined as the total number of accidents will increase with increasing demand.

Near-Term Initiatives are Delivering Measurable Improvements in NAS Performance

MITRE is working with the FAA and a broad range of aviation community stakeholders, which include air carriers, General Aviation, and manufacturers, to develop capabilities and procedures to address many of the delay and congestion problems outlined above, as well as to address needs for improved safety, efficiency, and airport access. For problems related to congestion and delays, there are many near-term procedure changes which have been implemented or are underway that leverage current aircraft avionics capabilities and that require minimal changes to

FAA systems. These and other initiatives are described in the FAA's NextGen Implementation Plan, which lays out the FAA's commitments for implementing operational improvements in the NAS.

The near-term initiatives include those related to area navigation and required navigation performance procedures, new wake vortex procedures to increase capacity for airports with closely spaced parallel runways, airspace redesign, improved procedures for General Aviation and small community access, new ADS-B services for General Aviation and commercial operators in the Gulf of Mexico, as well as new safety and efficiency initiatives. While important, these new capabilities and procedures will not fully meet today's needs for the NAS; for each of these topics I will also identify other initiatives that need to be done in the near term.

Area Navigation (RNAV) and Required Navigation Performance (RNP) Procedures

In the past, airspace design and utilization were the result of several limiting factors, including the dependence on the location of ground-based navigation aids (NAVAIDs) and conventional navigation methods, i.e., navigating from one VHF Omni-directional Range (VOR) to another. These conventional navigation methods lead to less-efficient routes, procedures and airspace usage.

The aviation community is moving forward in solving these problems by better utilizing capabilities already available on a majority of air transport and regional airline aircraft to perform Area Navigation (RNAV) and Required Navigation Performance (RNP) operations. Area Navigation enables aircraft to fly any desired path rather than flying to or from a fixed ground navigation aid. RNP takes advantage of on-board avionics coupled with satellite-based technology to navigate with more precision and accuracy for more efficient use of the airspace. RNAV and RNP aircraft capabilities have been steadily increasing over the past several years. MITRE's analysis suggests very high levels of RNAV equipage, in excess of 85% for many locations.

RNAV and RNP procedures are being implemented to establish precise arrival, approach and departure paths for aircraft. These procedures improve airport capacity and throughput, reduce the likelihood of aircraft collisions with terrain (known as Controlled Flight into Terrain, or CFIT), improve situational awareness for pilots and controllers, and facilitate smoother traffic flows. Using RNAV and RNP also enables the creation of procedures for airports where the terrain or infrastructure limitations make it difficult or impossible to safely fly conventional NAVAID procedures.

RNAV procedures are being used to increase terminal area ingress and egress, as well as increase runway use for departures. For example, Figure 3 illustrates the East and South departure flows from Atlanta; RNAV procedures have enabled additional departure streams in each direction. In addition, diverging (i.e., fanning out) RNAV departure procedures implemented at the Hartsfield-Jackson Atlanta International Airport (ATL) in 2006 have increased throughput and reduced delay with a measured capacity gain of 9-12 departures per hour. This equates to $30M annual benefit (at 2007 demand levels) and a calculated cumulative savings of $105M for the operators who flew these procedures through 2008. Similar procedures have been implemented at airports such as Dallas-Ft. Worth International Airport (DFW), Las Vegas – McCarran International Airport (LAS), Los Angeles International Airport (LAX) and Phoenix International Airport (PHX).

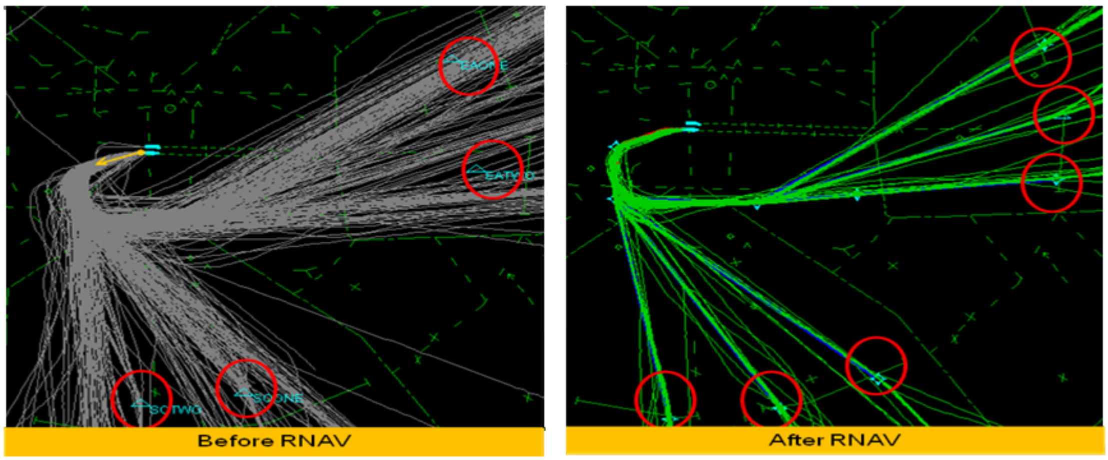


Figure 3 Atlanta Airport Departure Streams

RNP procedures improve the pilot's and the controller's situational awareness, and help to reduce pilot and controller workload and communication congestion through the use of precise, 3-dimensional instrument flight procedures. RNP systems on the aircraft are designed to monitor the current navigation performance of the aircraft. As a result, flight crews have a better understanding of how accurately the aircraft is flying and they are also alerted when the aircraft's navigation performance is inadequate for the desired procedure.

With the precision of RNP, aircraft can fly their planned routes precisely – and can do so reliably. As shown below (Figure 4), an analysis of arrivals at Portland International Airport (PDX) shows a significant reduction in the variability of flight tracks, resulting in both fuel savings and reduced emissions.

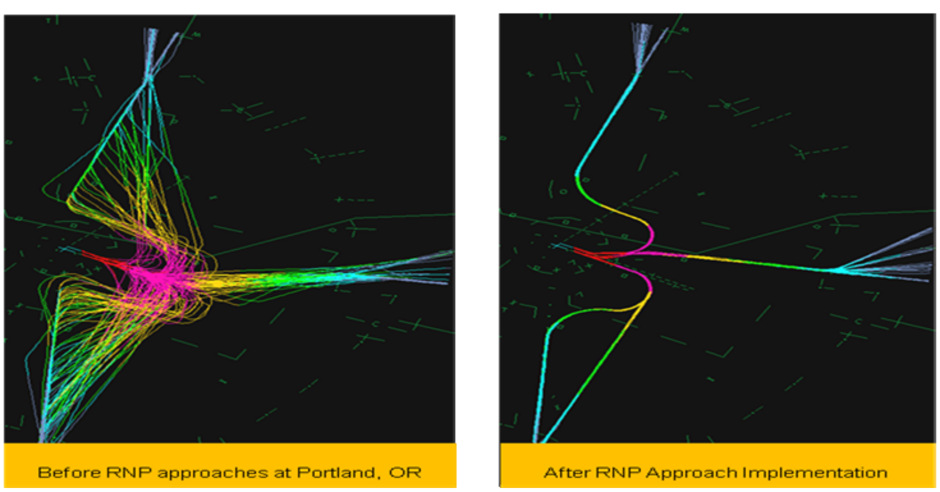


Figure 4 Portland Approach Flight Tracks

Similarly, at the Ronald Reagan Washington National Airport (DCA), RNP approach procedures have enabled aircraft to follow a precise path along the Potomac River, enabling flight operators who utilize this approach to more easily avoid accidentally entering prohibited airspace (see Figure 5).

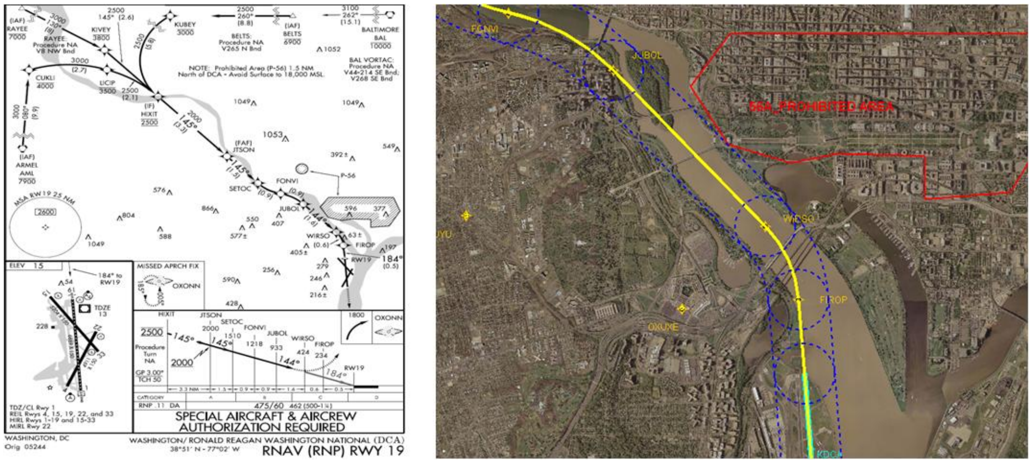


Figure 5 RNP Approach Procedure at DCA

In many metropolitan areas, arrival and departure paths at near-by airports can interfere with each other. This means that even in perfect weather conditions, an aircraft at one airport may be delayed on the ground while aircraft at a nearby airport are landing or departing. The greater precision and predictability of aircraft trajectories using RNP also makes it possible to address this problem by placing more arrival and departure routes in heavily congested airspace than would be possible using traditional navigation. For example, the use of an RNAV departure procedure at Chicago O'Hare International Airport (ORD) in combination with an RNP approach procedure for Chicago Midway Airport (MDW) allows both traffic streams to flow without interfering with each other (see Figure 6).

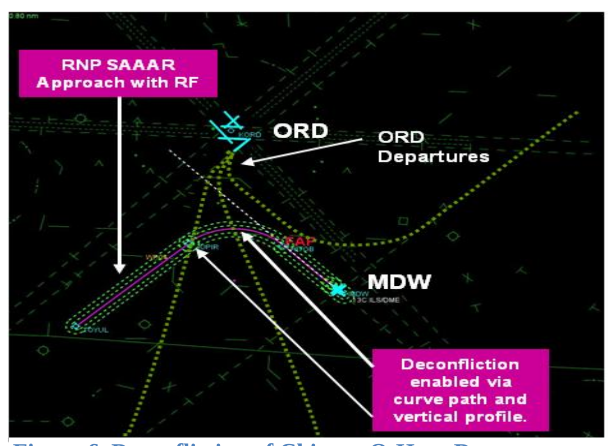


Figure 6 Deconfliction of Chicago O-Hare Departures and Midway Arrivals

The FAA and industry have implemented over 300 RNAV arrival and departure procedures, and have now implemented more than 130 RNP Special Aircraft and Aircrew Authorization Required (SAAAR) approach procedures. The FAA is planning to implement more than 50 RNAV arrival and departure procedures (Standard Terminal Arrival Routes [STARs] and Standard Instrument Departures [SIDs]) per year and over 25 RNP SAAAR approaches[4] per year. RNP SAAAR approaches can provide an alternative means of access to runway ends that currently cannot support an instrument landing system (ILS). For example, at Palm Springs International Airport (PSP), the

[4] RNP Special Aircraft and Aircrew Authorization Required (SAAAR) approaches are limited to an individual flight operator who is authorized to execute the procedures. Often, SAAAR approaches are precursors to more generally available "public" RNP procedures.

RNP SAAAR approach enabled increased access by reducing the ceiling and visibility requirements. Since implementation in 2005, Alaska Airlines reported over 20 instances where they were able to land utilizing the RNP SAAAR approach to PSP rather than divert, cancel, or incur delay greater than 15 minutes.

RNAV and RNP procedures are now beginning to populate the NAS, and many of the major arrival/departure flows now have RNAV procedures that overlay the historical vector patterns. These procedures, while beneficial now, need to move beyond basic overlays to incorporate more optimized profiles and flight path patterns that better address our capacity and throughput needs, improve airport arrivals and departures in the presence of terrain, and enable improved and efficient traffic flows. The challenges to addressing these non-overlay operations include addressing environmental hurdles and airspace designs. To enhance the smooth flow of traffic, we also need to better connect or "network" these procedures. This "network of procedures" is expected to improve aircraft arrivals and departures, eliminate conflicting flows among nearby airports, and connect city pairs with new routes for seamless, efficient flight. The FAA's *Capacity Needs in the National Airspace System 2007-2025* study (also known as FACT 2), identified several major metropolitan areas that will need additional capacity in 2015, even after planned improvements are implemented. Areas such as New York/Philadelphia, San Francisco Bay, and Southern California should be priority areas for these RNAV/RNP procedural improvements.

New Wake Procedures for Dependent Approaches to Parallel Runways Spaced Within 2500 Feet

Today, significant delays occur when airports with closely spaced parallel runways (less than 2500 feet apart) experience low-visibility weather conditions. Up to 60% of the arrival capacity (achievable in visual conditions) can be lost because wake separation procedures for low visibility conditions result in the two runways being treated as one.

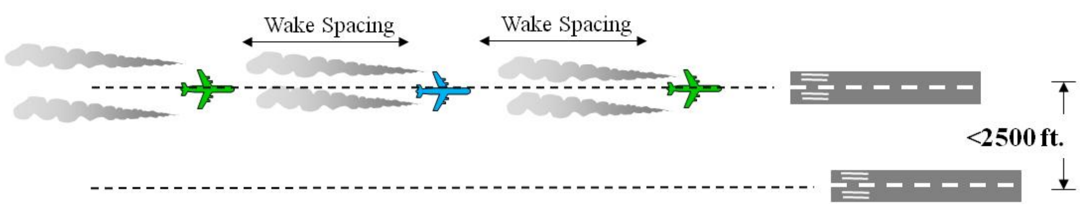


Figure 7 Airports with closely spaced parallel runways lose capacity in low visibility conditions

In September 2008, the FAA published a new Order that enables controllers at designated airports to run dependent operations (specifically, 1.5 nmi staggered approaches as illustrated in Figure 8) to parallel runways with centerlines less than 2500 feet apart, regaining some of the capacity lost in comparison to single-runway operations. This is a very low-cost operational improvement that requires no new avionics and no new airport ground equipment.

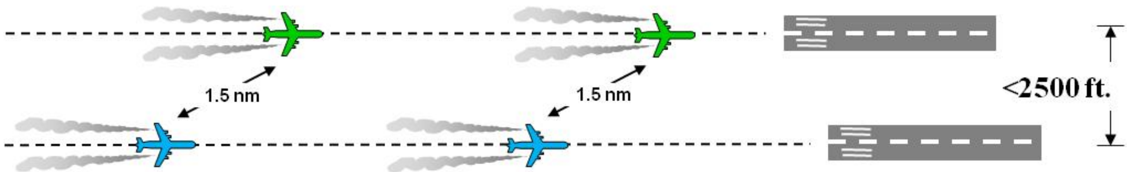


Figure 8 New procedures allow increased capacity for approved airports in low visibility conditions

The new procedure takes advantage of the arrival geometries to ensure the following aircraft does not encounter the wake turbulence generated by the lead aircraft. The airports that are approved in the Order to use this new procedure are Logan International Airport (BOS), Cleveland Hopkins International Airport (CLE), Philadelphia International Airport (PHL), Seattle-Tacoma International Airport (SEA), and Lambert-St. Louis International Airport (STL). Cleveland Hopkins International Airport, for example, experiences reduced visibility conditions about 23% of the time. With this new procedure, up to 16 additional aircraft will be able to land each hour during periods of low visibility.

Ninety percent of NAS delays are associated with the top ten delayed airports during non-visual conditions. Of those ten airports, this new wake procedure partially addresses the capacity losses due to low-visibility conditions at three of them (STL, BOS and PHL); this procedure currently applies only when leading aircraft are categorized as “large” or “small” (not “heavy” or B-757). Four other airports in the top ten for delays have closely spaced parallel runways but are not candidates for this procedure (ATL, SFO, EWR and LAX) due to both runway spacing and aircraft mix considerations. Work is in progress to identify other airports that may qualify for the 1.5 nmi staggered approach procedure. All indications are that these new procedures can be extended to aircraft categorized as Heavy or B-757. In addition, new approach procedures, such as changes in approach angle and glide slope, could enable reduced wake separations at additional airports.

Airspace Redesign is a Key Step in Reducing Congestion and Delays

Several ongoing airspace redesign projects are providing significant benefits by addressing growing congestion in the metropolitan areas most impacted by delay:

- The New York/New Jersey/Philadelphia Metropolitan Area Airspace Redesign is addressing congestion and delays in the airspace surrounding four of the most delayed airports in the U.S. (JFK, Newark, LaGuardia, and Philadelphia). The first stage of implementation began in late 2007; it included additional departure headings from Newark and Philadelphia. When the redesign is fully implemented in 2012, the projected benefits include a 20% reduction in delay and approximately $250 million in annual user benefits.

- The Chicago Airspace Project is improving the efficiency of the airspace surrounding Chicago’s O’Hare and Midway airports. Eastbound and southbound departure routes were added in 2007 and 2008 to provide additional pathways out of the metropolitan area. In November 2008, at the same time the new Runway 09L/27R was commissioned, a dual arrival feed from the southeast was added to take advantage of the additional runway

- In 2008 in the Houston metropolitan area, the Houston Area Air Traffic System (HAATS) project created a fifth northeast departure route that is reducing delays in an area of extreme congestion. By 2010, terminal airspace expansion to the east and west, new departure routes to the east and west, and dual corner post arrival routes will improve access to and egress from the Houston area and provide much-needed flexibility during severe weather events.

In addition to these projects, redesign efforts are focusing on the airspace in the southwest U.S. between Las Vegas, Phoenix, and southern California, as well as the high-altitude airspace linking major metropolitan areas throughout the country. All of these airspace redesign efforts are expected to reduce congestion, complexity, and delays throughout the NAS, and deliver benefits in annual operating costs for airspace users from $120 million annually in 2009 to $425 million annually by 2013.

Airspace redesigns improve the overall efficiency of the NAS, allow us to incorporate new capabilities (such as RNAV/RNP) and reduce delays. Other near-term needs for airspace improvements include the following:

- Expedite and expand enroute RNAV/RNP route ("Q"-route) development between key metropolitan areas that enable RNP-capable aircraft to fly more efficient routes
- Expand the Western Corridor airspace design to include terminal redesign for southern California and Phoenix
- Redesign terminal airspace at Denver and Dallas to address immediate needs identified by customers by extending the use of terminal separation standards further into enroute airspace

For many airspace redesign activities, the benefits achievable with the restructuring of routes and airspace are often delayed as local community concerns over environmental impacts are raised. For example, it took nearly seven years to complete the environmental review of the New York/New Jersey/Philadelphia Metropolitan Areas Redesign, and despite the FAA Record of Decision in September 2007, the project still faces a number of legal challenges, as well as numerous challenges related to implementation complexities. Given the critical need for improvements in areas of highly congested airspace, it is important that FAA continue efforts to streamline and accelerate the environmental review process and resources are directed to resolving environmental issues and implementation challenges as quickly as possible.

Improved Access to Aviation Services for Small Communities

New area navigation procedures also are being put in place to serve small communities and the General Aviation (GA) operations that are often a major contribution to the communities' broader needs. To facilitate GA operations at these community airports, new RNAV approach procedures with vertical guidance are providing low-visibility access for airports similar to what can be achieved using an Instrument Landing Systems (ILS). These procedures, which are made possible by GPS and the Wide Area Augmentation System (WAAS), do not require ILS equipment. There are currently 1333 RNAV approaches with vertical guidance around the US at 833 airports; additional procedures are being developed at the rate of 500 approaches per year. The FAA plans to continue developing these procedures until all qualified runways are served.

Improving access for small communities will allow further efficiencies to be gained, but more needs to be accomplished before implementation can be accelerated. Many of the runways that serve these smaller communities currently are not equipped with the standard instrument runway markings, lighting, and equipment found or required on our precision approach runways. We must determine the solutions that enable these RNAV precision-like operations to be functional on our non-precision runways, while achieving the highest levels of safety and minimizing expensive runway change requirements.

Automatic Dependent Surveillance – Broadcast (ADS-B) Improvements and Benefits

In 1999, the FAA started a program in Alaska, called Capstone, with the goal of lowering the high rate of fatal accidents for General Aviation and Air Taxi flights. The results of the Capstone program were dramatic—a 49% reduction in fatal accidents in that region for equipped aircraft. One of the key elements in the Capstone avionics suite was ADS-B avionics improving situational awareness for pilots as well as enabling surveillance services where radar was impractical to install. Additional operational experience with ADS-B was gained through the FAA's SafeFlight 21 program, which worked with the Cargo Airline Association and its members to demonstrate the benefits of ADS-B for air transport airlines. United Parcel Service (UPS) has since equipped their entire fleet with ADS-B and is reaping efficiency benefits today and demonstrating early NextGen benefits using a combination of ADS-B broadcasts plus avionics to display positions of other ADS-B-equipped aircraft.

Building on the knowledge gained, the FAA has established a program to implement the ground infrastructure needed to deliver ADS-B services and enable ADS-B applications nationwide. The national ADS-B ground infrastructure will provide several services that will benefit General Aviation. First, the FAA will transmit weather and NAS status information to the cockpit. This service, called Flight Information Services-Broadcast (FIS-B), will result in better decision making and reduce weather-related accidents, as well as reducing incursions into restricted airspace. The ADS-B ground infrastructure will also transmit information about nearby aircraft, derived from radar, to the cockpit. This service is called the Traffic Information Services-Broadcast (TIS-B). Equipped aircraft will also be able to display the positions of other ADS-B equipped aircraft transmitting their current position. TIS-B, in combination with received ADS-B data, will improve pilot situational awareness and reduce the likelihood of mid-air collisions. FIS-B and TIS-B services have been available to GA pilots in southern Florida since November 2008; such services will be available nationwide by 2013.

Part of the ADS-B program includes ground infrastructure deployed on oil platforms in the Gulf of Mexico to provide ATC surveillance where there is none today. Because of the lack of ATC surveillance over large areas of the Gulf, commercial aircraft flying between North America and Mexico, Central America, and South America must fly using large separations (approximately

100 nmi), which results in delayed flights or flights flying at sub-optimal, less-efficient altitudes. This new ADS-B infrastructure closes the current radar surveillance gap. As a result, air traffic controllers will be able to provide much closer separations than presently achieved, thus greatly increasing capacity. This new surveillance capability will also enable new, more efficient routes across the Gulf that were not practical with the current, limited radar coverage. New routes are expected to be in place by the end of this year. The increased capacity resulting from closer spacing, in combination with the better routes, is estimated to cumulatively deliver $18M through 2015 in benefits for flight operators in Gulf of Mexico high-altitude airspace.

Another group of users flying in the Gulf is the large fleet of helicopters that service the thousands of off-shore oil platforms. Operators of these aircraft receive few ATC services due to lack of low-altitude surveillance, and there is also a high incidence of weather-related accidents and mid-air collisions. Furthermore, most of the helicopter fleet is unable to operate during periods of poor visibility. Using the same ADS-B ground infrastructure deployed on the oil platforms, FIS-B and TIS-B services will be provided, improving pilot situational awareness and safety. Furthermore, with ADS-B surveillance available to controllers, these helicopters will be able to receive ATC services during all visibility conditions, further improving safety. ADS-B surveillance will also enable expanded ATC flight following and improved search and rescue operations in the Gulf. This improved low-altitude service for the helicopters is estimated to achieve $26M of benefits cumulatively through 2015 by improving capacity and safety.

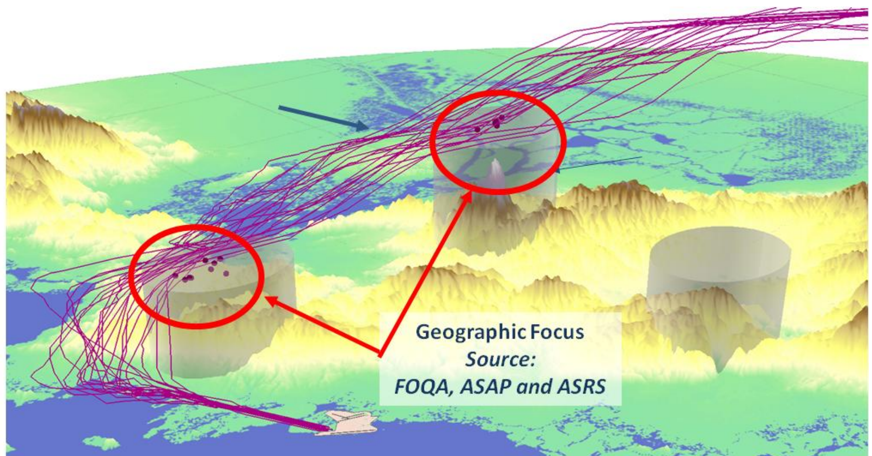
The key to achieving ADS-B national benefits is equipage. About half of U.S. commercial aircraft are equipped with ADS-B avionics today. However, most of these aircraft are not compliant with the standards that are included in the FAA's mandate, planned for 2020. Without early equipage or other mitigation of the difference in standards, most benefits will not be realized until that date is nearer. In the longer term, with the addition of cockpit displays and substantial ADS-B equipage, the potential benefits pool is much larger and equipage will be less of an issue, as costs are expected to drop substantially in the future.

Beyond the Gulf of Mexico, there are other needs that can be met with ADS-B surveillance to increase safety and efficiency of operations. ADS-B will enable ATC services in other non-radar areas, support expanded ATC flight following, and will improve search and rescue operations. Ultimately, the transition to ADS-B for surveillance will reduce ground radar infrastructure costs.

Near-Term Safety Initiatives

Important initiatives are underway that promise to deliver near-term safety benefits while also enabling many of NextGen's efficiency and capacity improvements. Fundamental to safety improvement is the implementation of data-driven safety management systems that enable identification and mitigation of evolving system risks. One of the key concepts for NextGen is the transformation from a forensic safety environment to one that is prognostic – to reduce the likelihood of accidents before they occur. Application of rigorous safety principals and methods across air traffic control, air carrier operations, aircraft maintenance, and airport operations holds the promise of more fully identifying causal factors, reducing error rates, and catching system risks prior to serious consequences.

An important recent initiative in early identification of risks is Aviation Safety Information Analysis and Sharing (ASIAS). ASIAS is a NextGen program sponsored by the FAA that integrates public and privately held aviation safety data from government and industry for the purpose of identifying safety trends and detection of systemic risks *before* they contribute to accidents. This voluntarily provided safety-related information, along with other publicly and non-publicly available data, is being used by MITRE at the request of FAA and industry stakeholders to proactively identify, analyze, and correct safety issues that affect commercial aviation. MITRE plays a central role in integrating the complex, disparate safety data from across industry and FAA, conducting national-level safety analyses, and ensuring fundamental protection of sensitive data.



A recent ASIAS study on Terrain Alerts integrated a wide range of data, including airport and airspace procedures and minimum vectoring altitude information from Air Traffic Control, weather data from FAA and NOAA, Terrain data is from the NASA Space Shuttle survey and actual tracks of traffic are from the FAA National offload program.

Figure 9

All major U.S. air carriers are currently participating in ASIAS, as is a growing set of regional air carriers and international carriers. A set of safety metrics is currently under development based on this unique safety data repository. Items such as location, frequency, and contributing factors for unstabilized approaches, Traffic Alert and Collision Avoidance System (TCAS) alerts, runway excursions, and Terrain Awareness Warning System (TAWS) alerts are just a few examples of safety analyses under way in ASIAS. Based on the TAWS analysis, several airports in the western half of the U.S. were identified as having substantial numbers of flights receiving terrain warnings. Contributing factors have been analyzed and turned over to the Commercial Aviation Safety Team who, with help from MITRE, the FAA, and other key members of the community, is developing recommended changes to avionics, airspace designs, and flight deck procedures.

Runway and surface safety capabilities are also being pursued aggressively. One activity with near-term safety impact involves analysis of alternatives for the Runway Status Lights, which is a runway safety warning system in development by the FAA that provides a visual warning to flight crews. The initial configuration for this system was validated in MITRE’s integrated Air Traffic Management laboratory and field tested at Dallas-Fort Worth International Airport (DFW), leading to a deployment decision in mid-2008. Extensions to this initial configuration that cover a greater number of surface risk scenarios continue to be evaluated. The Runway

Status Light system will significantly reduce runway incursions by mitigating the primary cause of incursions, which is erroneous runway crossings, whether due to pilot or controller error, at many of the largest airports.

Runway status light deployment begins at Phoenix airport, commissioning in Sept 2010, followed quickly by Baltimore/Washington International Thurgood Marshall Airport (BWI), Houston George Bush Intercontinental Airport (IAH), and others. Improvements for a total of 21 airports are currently funded. Other airports should also be candidates for this important safety improvement, including Memphis International Airport (MEM) and Cleveland-Hopkins International Airport (CLE).

In addition to runway status lights, more needs to be pursued to improve airport surface safety. For example, Electronic Flight Bag (EFB) technology is being enhanced to inform pilots about the safety status of runways and taxiways. There are public-private initiatives to expedite the development of this capability, and an initial field evaluation with prototype avionics is on track for mid-2010. This capability has the potential to reduce pilot errors and provide an additional safety net to mitigate controller errors at all airports throughout the NAS.

Efficiency Initiatives with Environmental Impact Benefits

Increased environmental awareness and volatility in jet fuel prices have stimulated the implementation of methods for reducing air transportation fuel consumption, pollutant emissions and noise. Two major international partnerships and many independent research programs are currently underway to investigate methods for reducing fuel burn, emissions, and noise in air transportation. These efforts span two oceans and include collaboration between industry, government and academia. In the Atlantic Ocean region, the Atlantic Interoperability Initiative to Reduce Emissions (AIRE) was formed with the goal to hasten development of environmental improvements for all phases of flight. In the Pacific Ocean region, the Asia and South Pacific Initiative to Reduce Emissions (ASPIRE) was formed to extend this goal to flights to and from Asia and the South Pacific. The results of one ASPIRE flight show a savings of 1173 gallons (3552 kg) of fuel and 11,214 kg of carbon dioxide emissions for a "perfect" flight that was given priority over others in the airspace for this evaluation. The savings resulted from a combination of steps, including just-in-time refueling, max climb power, user-preferred route, dynamic airspace reroute, and the definition of an arrival path to the destination airport that was optimized for the flight (called a “tailored arrival”). The tailored arrival portion of this flight alone was estimated to have saved 200 gallons of fuel with carbon dioxide emissions reduction estimated at 1912 kgs.

Within the descent phase of flight, an operational strategy for reducing these variables is to redesign arrival routes and procedures such that descending aircraft can reduce the application of thrust. By maintaining idle or near-idle engine speeds during descent, aircraft can minimize the fuel burned, the exhaust gases vented, and the noise generated by the engines. A general term for the broad class of descent routes and procedures, which are designed to reduce the application of thrust during descent, is Optimized Profile Descents (OPDs). Tailored arrivals, as mentioned above, are one kind of OPD.

Several domestic trial implementations of regularly scheduled flights have clarified the benefits and operational challenges of implementing OPDs. Four such trial implementations are the United Parcel Service (UPS) nighttime implementation at Louisville International-Standiford Field Airport (SDF) and the Standard Terminal Arrival Route (STAR) implementations at Los Angeles International Airport (LAX), Hartsfield-Jackson Atlanta International Airport (ATL), and Miami International Airport (MIA). These trials have also demonstrated fuel and emissions reduction benefits. The AIRE initiative's OPD trials at ATL and MIA, for example have demonstrated fuel saving benefits of 38-52 gallons of fuel per flight and a reduction of carbon dioxide emission savings of 360-500 kg per flight. Significant economic and environmental benefits can be gained if these procedures can be applied to a fraction of the 1280 daily arrivals at ATL, the 350 daily arrivals at MIA, as well as to other airport arrivals across the nation.

Overall, U.S. commercial aviation has improved its fuel efficiency over 23% in just the past 8 years. Optimal Profile Descents may allow further efficiencies to be gained, but more needs to be learned before implementation is accelerated. Accommodating OPDs may require airspace and sector redesigns and operational changes that account for the removal of the historical and planned level offs. Consequently, depending on site specific traffic flows, this may adversely affect overall airport and system efficiency in periods of high density or complexity.

Positioning the NAS to Meet Mid-Term and Long-Term Needs

To be ready for the mid-term, the FAA and the aviation community will need to put in place new capabilities that address both the growing demand and the increasing complexity of operations. The near-term initiatives described earlier are an important start, but will not fully resolve the problems the NAS will experience in the coming years. The FAA and the aviation community will need to invest in new technologies, procedures, and in some cases new policies to more completely address these future needs.

- **Achieving Aircraft Operations Closer to Today's Separation Standards**. Aircraft typically are separated at greater distances than prescribed by the minimum separation requirements defined in FAA procedures and standards. Buffers are added by controllers to address the uncertainty in actual aircraft positions (from surveillance and navigation uncertainty) as well as to reduce the likelihood of violating the separation minima. If these buffers can be reduced by reducing the uncertainty in aircraft position, capacity and efficiency benefits can immediately be gained. This translates into improved aircraft spacing on final approaches, improved transitions to and from airports to en route streams, expanding the use of runways that cannot be used in low-visibility conditions today, and reducing miles-in-trail and lateral spacing typically used today.

- **Closely Spaced Parallel Runway Operations.** Other procedures and additional technology are needed that go beyond wake-based procedures. For example, procedures using information about prevailing winds and wake drift calculations are in development and should continue to be pursued; these will increase the number of airports that regain a portion of the capacity lost during low visibility operations. Work is on-going to develop new

- **Surface Traffic Management and Surveillance**. Another major area for improvement at the busiest airports is to increase the efficiency of operations on the airport surface, and to better manage arrival and departure flows. Surface surveillance (ASDE-X) implementation is in progress for 35 airports, covering taxiways and runways. The FAA needs to accelerate surface surveillance coverage for ramp areas, accelerate the integration of surface event data into Traffic Flow Management (TFM) / departure management systems, and expedite data sharing with flight operators. In addition, there is little automation today supporting the efficient management of surface traffic, and operations are still highly reliant on direct human observation of aircraft movements. New surface management procedures and technologies can have a significant impact on overall delays, 20% of which occurs during the taxi out phase of flight. These improvements, expected to be in place by 2018, include real-time exchange of data between flight operators and ATC, airport configuration tools to assess optimal airport runway configurations to address changing weather and air traffic demand patterns, improved departure scheduling capabilities that smartly sequence departing aircraft in the context of the overall traffic patterns and constraints, and better tools for selection, assignment, and monitoring of taxi routes on the airport surface.

- **Air-Ground Data Communications**. Air Traffic Control involves exchanging information, clearances, and instructions between pilots and controllers. In the current ATC environment, the principal means for this communication is voice transmission via radio. The evolution from a voice-only system to a system that includes both air-ground voice and data communications is a major enabler for NextGen benefits, including greater capacity and safety levels than can be achieved today. To implement a modernized data communications environment, the NAS needs to evolve into a system that can: 1) enhance current voice-only operations to provide early benefits, 2) integrate data communications with emerging automation capabilities, and 3) enable longer-term, more-advanced trajectory clearances that incorporate vertical, horizontal and time components (which is called 4D trajectory operations). Taking the first step is critical. FAA and flight operators need to work together to implement Data Communications Segment 1, while continuing to develop concepts and standards for advanced data communications capabilities.

- **New Decision Support Tools for Controllers and Traffic Flow Managers.** As traffic density and complexity increase, additional automation tools will be needed to help controllers and traffic flow managers maintain today's level of services while increasing their productivity. Decision support aids include conformance monitoring tools to alert controllers if an aircraft leaves an assigned route; tools to assist with traffic metering, merging and spacing; tools to provide strategic solutions to anticipated separation or traffic management problems; and new congestion management tools that minimize overall impacts to traffic and that better anticipate the impacts of changing weather conditions. Traffic Flow Management (TFM) tools will support collaboration between the FAA and flight operators, and allow us to better anticipate the impacts of severe weather on traffic flow and quickly plan strategies for

- **New Decision Support Tools for Pilots and Flight Crews.** As we move towards NextGen, the efficiency of the NAS will increasingly rely on capabilities in the aircraft. In the mid-term (2012 – 2018), new cockpit tools (leveraging on ADS-B) to support delegated spacing and merging will complement ATC automation and new RNAV/RNP procedures. Cockpit capabilities to extend highly efficient visual approach operations to lower visibility conditions are also in development.

The capabilities described above are not only necessary components for mid-term NextGen, they also lay the foundation for the long-term NextGen envisioned for 2025 and beyond. By then, traffic densities and complexities are expected to be significantly more challenging than in this decade, and MITRE believes that to meet this long-term challenge there will need to be an increased role for automation; new technologies; new policies and procedures; and changes to the roles of controllers, pilots, and dispatch personnel to support new concepts and increase overall productivity and efficiency. Maturing these ideas is an important research task. It is important, however, to not let postulated solutions to achieve the long-term NextGen vision delay needed progress in the near-term and mid-term time frames.

The Need for Collaboration among Government and Industry Stakeholders

There are a number of ways the FAA and the aviation community are collaborating today that are making important contributions to NextGen. For example, the Performance-Based Aviation Rulemaking Committee, or PARC, has added tremendous value over the years both in developing RNAV/RNP concepts and procedures and in developing FAA/aviation community consensus on priorities. The Commercial Aviation Safety Team, or CAST, has made numerous contributions to overall aviation safety, due to its collaborative nature. RTCA is also important, both for the development of avionics standards and for its overall work with FAA in understanding NextGen concepts and aviation community priorities.

By the 2014 to 2018 time frame, many major improvements in capacity and system-wide efficiencies will depend on flight operator investments in additional avionics equipage; this is more so for the far term. Planning for these new aircraft capabilities, however, needs to consider realistic lead-times for development of standards, creation of products, training, and aircraft installation, as well as the development of new procedures and complementary ATC automation.

One important venue for collaboration between the FAA and the aviation community is the RTCA NextGen Implementation Task Force. The Task Force was recently convened at the request of the FAA to establish a dialog with the aviation community on overall priorities and strategies to implement near-term and mid-term improvements that provide benefit both to individual operators as well as the FAA. The Task Force will be a valuable venue for gaining clarity on the several concerns related to investments needed both for avionics and for the NAS as a whole:

- The FAA's NextGen Implementation Plan is the first step to developing common plans among the FAA and flight operators, who are concerned about ensuring adequate return on investment for avionics. FAA and operators need to work closely together in setting specific goals, in planning, and in execution. Joint plans must reflect all the needed elements and be synchronized so that they will be ready at the same time and place, and so that when avionics are installed they can be used as intended and deliver improved operations and benefits. Executing these plans will require coordination at the working level, but equally important will be joint on-going oversight of progress so that stakeholders can hold each other accountable.

- As part of this, a well thought-out, integrated avionics evolution plan is needed to achieve timely benefits for individual operators and for the system as a whole. One essential element of this is coordinated planning within the FAA for all programs that involve changes to deliver new benefits to avionics. Aligning plans across programs will help avoid having to take aircraft out of service multiple times for installations and upgrades, multiple revisions (and re-certification) to key aircraft elements such as the wiring harness or the Flight Management System, and training and re-training on incremental changes in procedures.

- FAA and operators also will need to work together on policies and procedures so that those who invest in new avionics can gain benefits without having to wait for a majority of the fleet to equip. FAA has proposed to shift the policies and practices of "first come - first served" toward "best equipped - best served" *when doing so will improve the operation of the system as a whol*e. An important example of this is data communications, which allows large capacity improvements in the ATC system – thereby benefiting all aircraft whether equipped or not. By changing procedures to get these equipped aircraft through and out of constrained areas first (which is easier to do because of their equipage), the system as a whole will benefit, but a larger share of that benefit will be directed to the equipped aircraft.

Collaboration to achieve near-, mid-, or far-term NextGen benefits is not limited to the FAA and flight operators, however. The value of our National Airspace System depends on the contributions of multiple government agencies and departments. NASA is researching new technologies and concepts; their work on engines and fuels, for example, is important both in terms of efficiency and environmental impacts. The DOC is partnering with the FAA in moving weather information into an integrated automation environment and in developing the 4D Weather Cube. The aviation community is looking to the DOD, with their experience in net-centric operations, to help apply that technology for interagency collaboration and enhanced data exchange. Expanding needs across multiple agencies for the use of Unmanned Aircraft Systems (UAS) will require new innovation to balance those needs with other traffic demands and will require FAA to work closely with both DOD and DHS.

Summary

I would like to close this testimony by summarizing some of the major initiatives that support near-term goals for NextGen. There are many near-term improvements that make a real difference in the performance of the NAS and in serving communities, large and small. These include:

- Procedures that reduce delays at major airports, some building on aircraft equipage with RNAV/RNP and others taking advantage of new wake avoidance procedures for parallel runways.
- Reductions in the airspace congestion through innovative airspace redesigns in major metropolitan areas.
- New RNAV approach procedures with vertical guidance to serve small communities by providing improved access to airports in low-visibility conditions.
- The ADS-B program to serve a broad set of General Aviation users with improved traffic and flight information services (TIS-B and FIS-B) and commercial operations in the Gulf of Mexico.
- Safety initiatives, such as ASIAS and new electronic flight bag capabilities to improve pilot situational awareness, in order to make our already safe system even safer despite increasing traffic levels at congested airports.

There are also steps that the FAA and the aviation community need to start now so that we are ready to face the challenges of 2015 and beyond. This includes increasing capacity by better achieving today's separation standards and by reducing the separation between aircraft where needed and still be operationally safe. Closely spaced parallel operations are one example where continued progress will be needed if we are to meet the traffic demands in the future. Other critical areas needing continued emphasis include surface traffic management and implementation of air-ground data communications for air traffic control. These investments will take us a long way towards meeting the NextGen needs in the 2018 timeframe while laying the foundation for the long-term NextGen vision.

And finally, it is important to recognize that implementing NextGen will require significant collaboration and investment across multiple government agencies, as well as private industry. Without this collaboration, the gains achieved in the near-term will be overshadowed by the challenges that are coming in the future.

Mr. Chairman, this concludes my testimony. I would be happy to answer any questions the Committee may have.